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U. S. WAR DEPT. TECHNICAL MANUAL 8-616
ELECTRO-SURGICAL UNIT, PORTABLE

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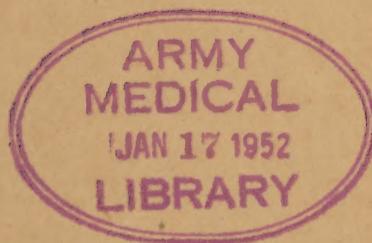
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TM 8-616

WAR DEPARTMENT TECHNICAL MANUAL

ELECTRO-SURGICAL UNIT,
PORTABLE



WAR DEPARTMENT • 30 AUGUST 1944

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TM 8-616

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TM 8-616, Electro-Surgical Unit, Portable, is published for the information and guidance of all concerned.

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BY ORDER OF THE SECRETARY OF WAR:

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For explanation of symbols, see FM 21-6.

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SECTION I

GENERAL

1. SCOPE. This manual is published for the information and guidance of all personnel charged with the operation and maintenance of Electro-Surgical Unit, Portable, Medical Department No. 36703 (fig. 1) in the field. This manual is concerned chiefly with assembling, operation, maintenance, and packing of the unit. There is appended a standard nomenclature list of parts. Illustrations show the component parts and accessories described in the text.

2. DESCRIPTION. The Electro-Surgical Unit, Portable, item No. 36703, a standard type electrical surgical unit with two high-frequency oscillating currents combined in a single housing. One current generated is a cutting current, the other is a highly damped wave form for coagulation. A single selector switch permits instant change from cutting to coagulating current without release of the electrode in hand. A foot switch, 3R01656 (fig. 5), completes the control system. The unit is mounted in a compact, portable case with a compartment in the cover for accessories.

3. DATA. Data pertinent to the operation of the machine are as follows:

a. This machine is designed to operate on either 115 volts—14 amperes or 230 volts—7 amperes, 50 or 60 cycles. The terminal board must be set correctly for the voltage used.

b. Manufacturer. Liebel-Flarsheim Co., Cincinnati, Ohio.

4. ASSEMBLIES. The Electro-Surgical Unit, Portable, consists of the unit completely inclosed in the carrying case (figs. 1, 2, and 3) and the accessories (figs. 3, 4, and 5) inclosed in the cover.

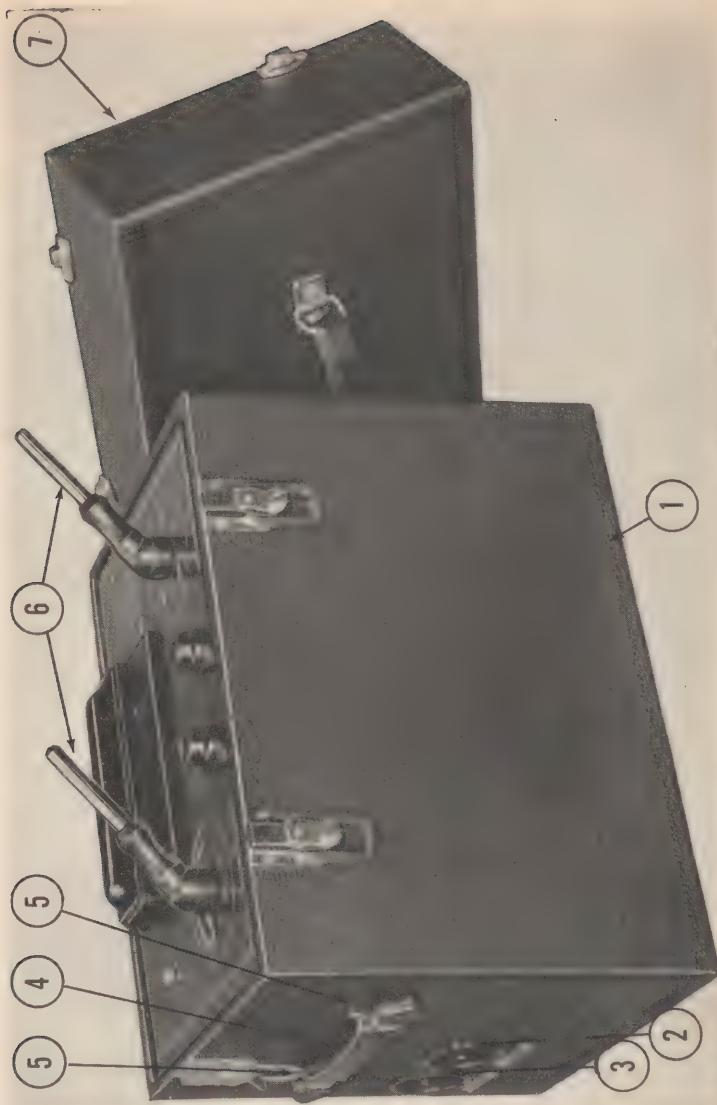


Figure 1. *Electro-Surgical Unit, Portable.*

1. 3R01704 Case, Carrying, Complete; With hasps.
2. 3R01692 Plug, Male, Two Prong, Recessed; For power supply attachment.
3. 3R01690 Receptacle, Female, Two Prong; For foot switch attachment.
4. 3R01662 Handle, Carrying Case, Leather.
5. 3R01664 Clamp, Carrying Case Handle.
6. 3R01604 Handle, Sterilizable, Carrying Case, Complete; With compartment for accessories.
7. 3R01706 Cover, Carrying Case, Complete.

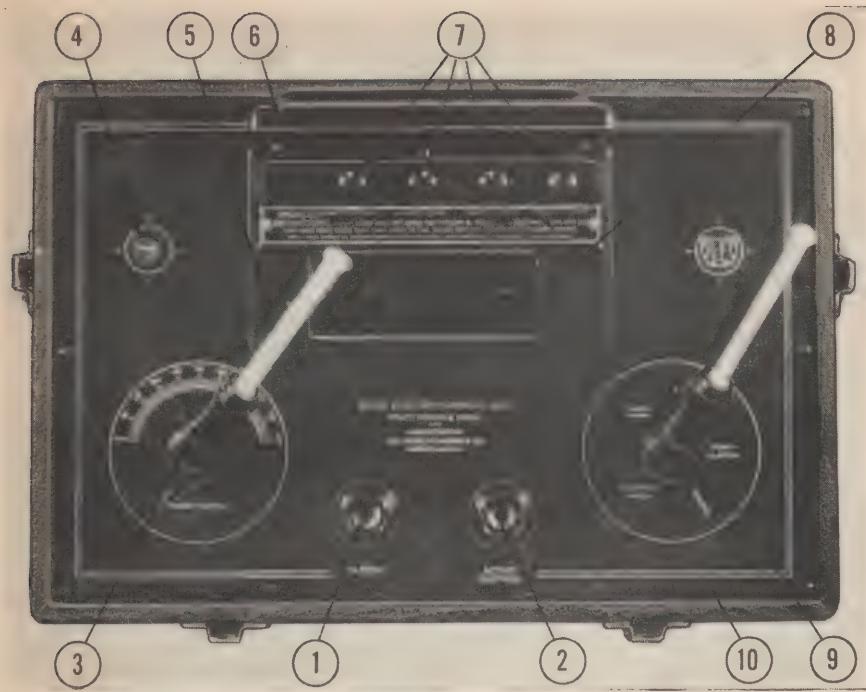


Figure 2. Electro-Surgical Unit, Portable, top view.

1. 3R01702 Guide, Patient Electrode Plug, Plastic, Round.
2. 3R01700 Guide, Active Electrode Plug, Plastic, Square.
3. 3R01672 Holder, Power Control Handle, Plastic.
4. 3R01654 Bulb, Pilot, 1/4 Watt, 110 V.
5. 3R01696 Frame, Observation Window, Plastic.
6. 3R01698 Cover, Spark Gap Adjustment Knob, Plastic: Assembly.
7. 3R01650 Knob, Spark Gap Adjustment.
8. 3R01694 Window, Observation, 2 1/8 Inch x 5 3/8 Inch, Glass: Colored.
9. 3R01668 Holder, Selector Switch Handle, Plastic.
10. 3R01738 Panel, Top, Plastic: For carrying case.

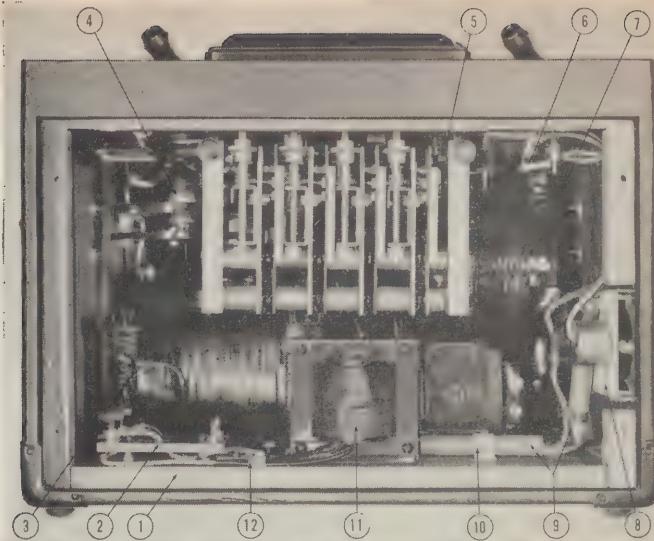


Figure 3A. Electro-Surgical Unit, Portable, inside view, bottom half.

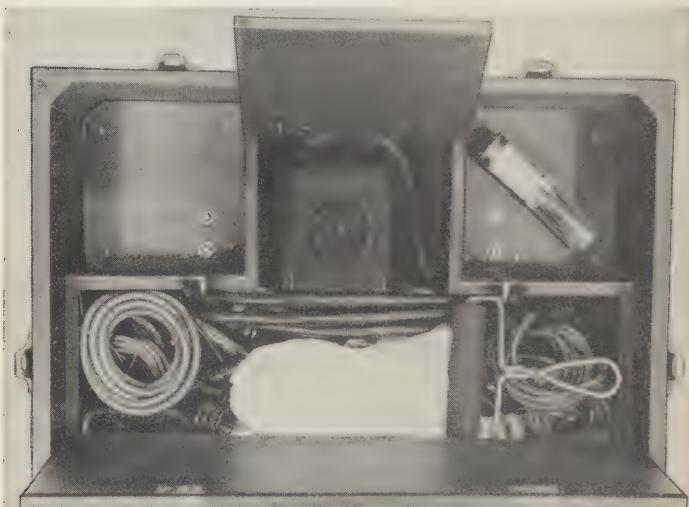


Figure 3B. Electro-Surgical Unit, Portable, top half.

1. 3R01740 Board, Mounting, 10 1/4 inch x 15 3/8 inch x 5/8 inch, Bottom, Wood.
2. 3R01720 Board, Terminal: For adjusting voltage, 115/230 volts.
3. 3R01724 Transformer, 115/230 V., 50/60 Cycles, Complete: Assembly.
4. 3R01666 Switch, Selector, Complete: Assembly.
5. 3R01652 Gap, Cutting, Four Gap, Complete: Assembly.
6. 3R01686 Resistor, 50,000 Ohms.
7. 3R01670 Control, Power, Complete: Assembly.
8. 3R01688 Bracket, Receptacle, Complete: For supply and foot switch attachment.
9. SRO0286 Tubing, 1/2 inch, Fibre, Solid: Used to protect wiring.
10. SRO0287 Strap, Pipe, 1/2 inch, One Hole: For securing fibre tubing.
11. 3R01674 Coil, Choke, 115/230 V., 50/60 Cycles.
12. 3R01734 Clamp, Wire, Plastic: Used to secure leads from choke coil and transformer.

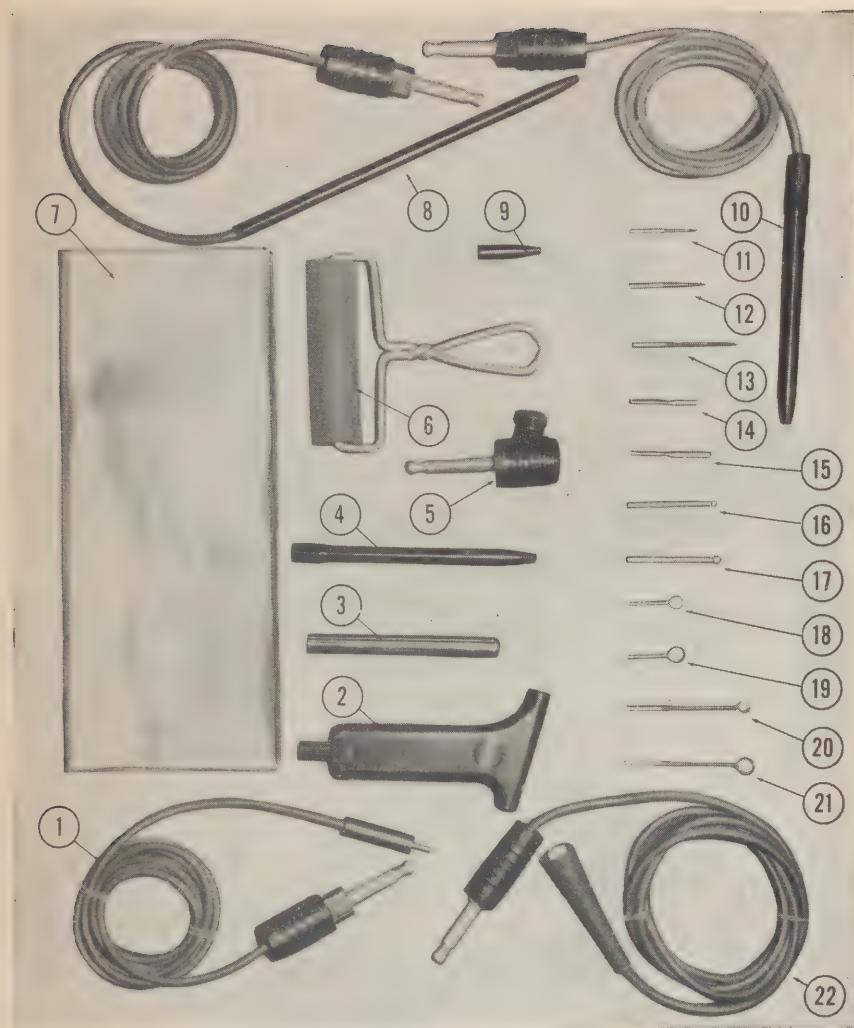


Figure 4. Accessories.

1. 3R01616 Cord, High Frequency, Complete: With square plug.
2. 3R01608 Grip, Offset: For long chuck handle.
3. 3R01604 Handle, Sterilizable.
4. 3R01658 Sleeve, Short Chuck Handle, Bakelite: For short chuck handle.
5. 3R01620 Plug, Adaptor.
6. 3R01610 Roller, Electrode, Rubber.
7. 3R01644 Electrode, Patient, Metal.
8. 3R01606 Handle, Long Chuck, Complete: With square plug and cord.
9. 3R01602 Nose, Chuck: For long chuck.
10. 3R01612 Handle, Small Chuck, Complete: With square plug and cord.
11. 3R01626 Electrode, Small Needle.
12. 3R01628 Electrode, Large Needle.
13. 3R01642 Electrode, Needle, Neuro-Surgical.
14. 3R01622 Electrode, Small Blade, Straight.
15. 3R01624 Electrode, Large Blade, Straight.
16. 3R01634 Electrode, Ball, 1/8 inch.
17. 3R01636 Electrode, Ball, 3/16 inch.
18. 3R01630 Electrode, Round Loop, 1/4 inch.
19. 3R01632 Electrode, Round Loop, 5/16 inch.
20. 3R01638 Electrode, Loop, Neuro-Surgical, 1/4 inch.
21. 3R01640 Electrode, Loop, Neuro-Surgical, 5/16 inch.
22. 3R01618 Cord, Patient, Complete: With round plug and rubber covered clip.

a. The unit includes the carrying case, complete with handles and hasps, 3R01704 (fig. 1), the various controls, and spark gap assembly, 3R01652 (figs. 3 and 6).

b. The accessories include the foot switch, 3R01656 (fig. 5), the supply cord, 3R01646 (fig. 5), and the operation electrodes and handles (fig. 4).

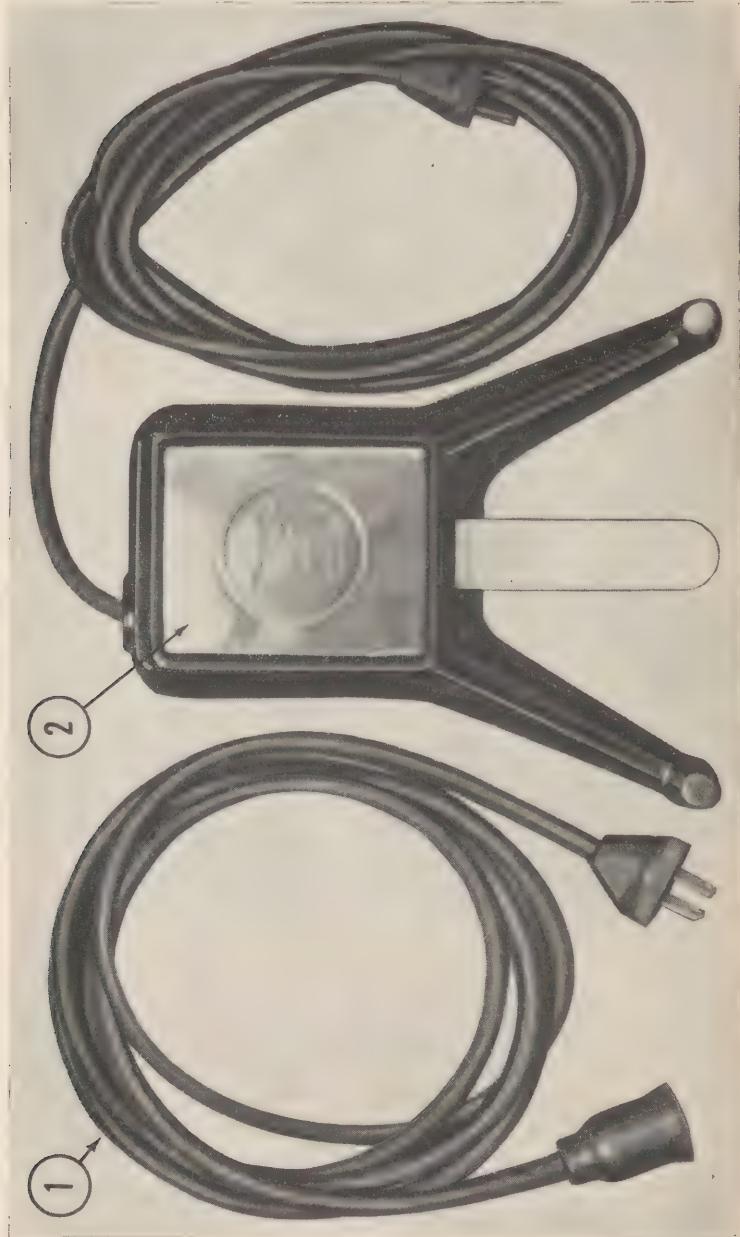


Figure 5. Foot switch and supply cord.

1. 3R01646 Cable, Supply, Complete: With plug and receptacle.
2. 3R01656 Switch, Foot, Complete: Assembly with cord and plug.

SECTION II

PACKING AND ASSEMBLING

5. UNPACKING. To unpack the Electro-Surgical Unit, Portable, proceed as follows:

- a.** Open shipping box carefully. Remove paper packing so as to uncover case. Lift the case carefully from the shipping box.
- b.** The Electro-Surgical Unit, Portable, is issued in its carrying case assembled and ready for operation except for plugging in electrical connections, adjusting the spark gap assembly, 3R01652 (figs. 3 and 6), and attaching accessories.
- c.** To unpack the accessories, open case and remove from compartment in the cover.

6. ASSEMBLING. To assemble the Electro-Surgical Unit, Portable, for operation proceed as follows:

- a.** Remove accessories from compartment in cover.
- b.** Connect supply cable, 3R01646 (fig. 5), and foot switch, 3R01656 (fig. 5), to plugs on side of case (fig. 1). Spark gap adjustment should be made at this point before other accessories are assembled. (See par. 8.)
- c.** Connect indifferent electrode, 3R01644 (fig. 4), to the terminal marked "Patient", using the cord with clip on one end and round plug on the other, 3R01618 (fig. 4). The clip is fastened onto the metal indifferent plate, 3R01644 (fig. 4).
- d.** When used with aseptic surgery the various parts that require touching or handling during operation should be sterilized before they are connected. These parts include the handles, 3R01604 (fig. 1), the chuck handle and cord and the required operating electrodes (fig. 4). (See par. 10).
- e.** Insert sterilizable handles, 3R01604 (fig. 4), into handle holders (fig. 1). Turn handle two or three turns clockwise to lock in place.
- f.** Insert operating electrode in chuck handle (fig. 4) by unscrewing to release chuck, inserting the electrode and then tightening chuck carefully.

g. Connect square terminal plug on chuck handle (fig. 4) to the terminal marked "Active Electrode" (fig. 2).

h. With all connections made and the spark gap adjusted the machine is ready for service with the exception of power control adjustment which is covered in paragraph 9.

7. DISASSEMBLING AND PACKING. To disassemble and pack the Electro-Surgical Unit, Portable, portable, proceed as follows:

a. Disconnect supply cable, 3R01646 (fig. 5) and foot switch, 3R01615 (fig. 5).

b. Remove other accessories.

c. Clean equipment thoroughly.

d. Wrap accessories in tissue paper or cloth to prevent breakage and replace in accessory compartment in cover. Care must be exercised in repacking accessories in order to fit them into space provided.

e. Fasten cover on case by locking the hasps.

f. Pack case securely in wooden box using insulating material to prevent jarring in transit.

OPERATION

8. ADJUSTING SPARK GAPS. **a.** Firing of the gaps may be observed through the glass window, 3R01694 (fig. 2). Immediately above each gap is its adjustment knob, 3R01650 (fig. 2). Turning the knob clockwise closes the gap; counterclockwise opens the gap. As the quality of the current is dependent on spark gap adjustment, it is essential that this operation be accurately and properly performed.

b. First move selector switch (fig. 2) to either the "Scalpel" or "Coagulation" position. Step on foot switch, 3R01656 (fig. 5) to start current flow through gaps. Then look at the gaps through observation window, 3R01694 (fig. 2). If any of the gaps are not firing, turn the proper adjusting knob, 3R01650 (figs. 2 and 6) counterclockwise to open the gaps slightly until all start to fire. It is essential that all gaps be firing prior to adjustment.

c. The observer's eye must be lined up directly with sparking surface of the gap being adjusted. The best way is to close one eye, and moving the head laterally in front of the gap, stop at the point where firing seems most intense. The arc is quite small and if viewed from even a moderate angle, the first sparking of the gap may not be seen.

d. When correctly adjusted, intensity of the arc in each gap should appear about the same to the eye. If a particular gap appears to fire with less intensity than the others, it probably means that it has not been opened enough and should be completely readjusted. If any one gap fires irregularly or sputters, the gap needs readjustment because it has been opened too wide.

e. With the gaps properly adjusted, the arc that takes place when the current is on can scarcely be heard. (Don't confuse the 60-cycle transformer hum with the high pitched hissing note of the arc.) If one or more of the gaps are opened too wide, or if they are adjusted improperly so that one takes most of the load, there will be a decided sputtering in that one gap (or all gaps, if all are open too wide). The sputter can be seen and its crackling sound is distinctly heard. A single sputter at rare intervals is of no consequence, but if heard often or continuously, all gaps should be correctly adjusted.

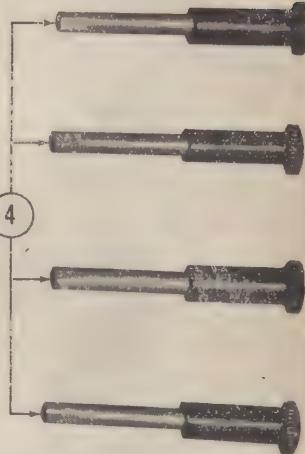
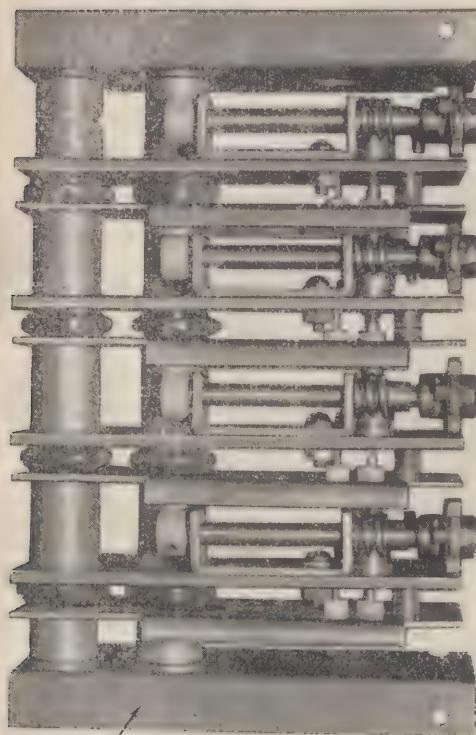
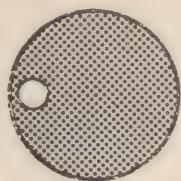


Figure 6. Spark gap assembly.

1. 3R01652 Gap, Cutting, Four-Gap, Complete: Assembly.
2. 3R01648 Nut, Spark Gap Mounting.
3. 3R01744 Washer, Coil, Spring, #10: Used in spark gap mounting and terminal board.
4. 3R01650 Knob, Spark Gap Adjustment.

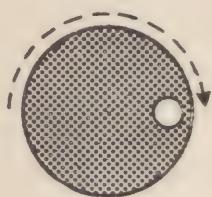
GAP ADJUSTMENT

1



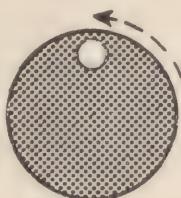
GAP FIRING

2



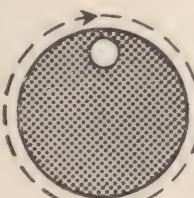
GAP STOPS FIRING

3



GAP STARTS
TO SPARK

4



ONE FULL TURN
ADJUSTS GAP

1. After all gaps are firing, take each individual gap (for example, start at left and work to right), carefully align your eye with the gap being adjusted and

2. Turn its adjustment knob CLOCKWISE until it stops firing.

3. Slowly turn knob COUNTER-CLOCKWISE until you see the gap start to spark, then STOP.—and note position of small white dot on knob.

4. From the point where continuous sparking was first observed, TURN KNOB COUNTER-CLOCKWISE ONE FULL TURN, which will put that particular gap in proper adjustment.

ADJUST ALL GAPS IN
THIS MANNER.

Figure 7. Adjusting spark gaps.

f. Correct gap adjustment is essential to satisfactory operation, particularly of the cutting current. If the machine seems to lack cutting power, if it cuts slowly, or if there is an excessive amount of dehydrated tissue on edges of the wound, these are sure signs that the gaps are not in adjustment and they should be properly set before further use.

9. POWER CONTROL SETTINGS FOR ELECTRICAL CUTTING. **a.** The single control at left front on the top panel (fig. 2) varies the power of both the cutting and coagulation currents. This control is effective when either current is turned on. Rotating through its graduated scale, it affords a constant, unbroken range of power from zero up to maximum output of the current in use. The scale is purely arbitrary, indicating the relative current strength between minimum and maximum settings. The amount of power required for any given type of work, either cutting or coagulation, involves a number of variables so that experience and familiarity with the machine and different electrodes will be of more value than any arbitrary figure that may be set. However, if the fundamentals are thoroughly understood, the operator will, with a little experience, have no difficulty in arriving at the correct settings to use under different conditions.

b. Cutting power required in general surgery will vary depending on—

(1) *Nature of tissue being sectioned.* Fatty tissue or cartilage requires more power than skin or muscle tissue. Sclerotic, fibrotic, or cicatrical tissue will require more power than softer structures.

(2) *Depth of incision.* A deep incision (with the same electrode and a given speed of cut) requires more power than a shallow one.

(3) *Rate of speed at which cutting electrode is moved.* Fast cuts require more power than slow.

(4) *Type of electrode used.* For a given depth of incision with equivalent speed of cutting, the amount of power required will depend on the thickness of the electrode used. The thinner the electrode the less power required.

c. With these powers in mind, it can be seen that the power settings are not fixed arbitrary figures, subject to no variation; rather, the operator should learn that this is a flexible factor and that the best results are secured by varying the power setting to meet the immediate conditions.

d. There is one safe rule to follow: "Use the lowest possible power setting which cuts freely to the desired depth with the electrode in use." This rule, if followed, will result in a minimum of sparking and flashing at the electrode, will prolong the life of operating instruments, and will prevent charring or excessive coagulation of the wound edges.

e. (1) Power setting for electro-coagulation and desiccation. For this work, current is applied by various methods through electrodes of different sizes and shapes so that an understanding of the different conditions is necessary before power setting can be worked out.

(a) *Electro-coagulation* can be defined as a process in which a high frequency current is employed to "cook" tissue surrounding the active electrodes. Enough heat to do this is generated within the tissue by the current passing from the electrode into the surrounding tissue.

(b) *Electro-desiccation* is a procedure similar to electro-coagulation except that the active electrode is not placed in actual contact with tissue. Current is allowed to jump through space and, sparking onto the surface being treated, dehydrates the superficial layers of tissue.

(2) These two methods of application produce exactly the same effect on tissue. The cells so treated are dehydrated, or coagulated, the difference being that contact coagulation penetrates more deeply, causes a greater depth of destruction; whereas desiccation affects only the superficial layers.

(3) Both coagulation and desiccation can be done with or without an indifferent electrode. To denote these two conditions the following terms are used:

(a) *Monopolar*, when a single active electrode is used without an indifferent electrode.

(b) *Bipolar*, when an indifferent electrode is used for current return path.

(4) These terms, monopolar and bipolar, are used merely to indicate the method of applying current. There is no difference in the surgical effect of the current or in their electrical characteristics. The only difference is in the amount of power secured from a given setting. For a given power setting, more current is obtained with bipolar applications than with monopolar. The amount of power required for this work varies widely and depends on—

(a) Size of electrode used.

(b) Area of electrode in contact with tissue.

(c) Depth and area of destruction desired.

(d) Length of time current is applied.

(5) Again, it is not possible to give definite power settings for various classes of work, but the following will serve as a starting point.

(a) *Monopolar desiccation.*

Very light—10 to 20.

Light—20 to 35.

Medium—35 to 50.

Heavy—50 upward.

(b) *Bipolar coagulation.*

Very light—5 to 10.

Light—10 to 20.

Medium—20 to 35.

Heavy—35 upward.

(c) *Bladder fulguration.* From 45 to 65, depending on size and amount of destruction desired.

(d) Settings above will apply when current is used for tissue destruction.

(6) For electro-hemostasis by clamp and coagulation method, power requirements will vary considerably, depending on the size of the clamp used, the amount of tissue picked up, the size of the bleeder, and other factors. In general, however, a power setting of around 35 (bipolar method) will prove adequate if only small amounts of tissue are picked up in the clamp and from 40 to 45 if larger clamps are used and larger bits of tissue picked up.

10. STERILIZATION OF ELECTRODES AND ACCESSORIES. a. In preparing the Electro-Surgical Unit, Portable, for aseptic surgery, all parts which are handled or touched in the course of an operation should be sterilized prior to use. These include the operating electrode handles with their cords (fig. 4); the sterilizable handles, 3R01604 (fig. 4) which fit into power control and selector switch; all needles, knives, loops, blades, and other operating instruments (fig. 4).

b. The metal parts, including the loops, needles, knives, etc. (fig. 4) can be sterilized by prolonged boiling or autoclaving without damage.

c. However, the bakelite handles and rubber cords are subject to some deterioration if subjected to prolonged heat sterilization and they will need replacement from time to time.

d. The useful life of the handles and cords (fig. 4) can be lengthened by sterilization in some adequate cold solution (see par. 11c), but cold sterilization is not recommended in neuro-surgery, operation in the thoracic cavity, or in the abdomen where immaculate conditions are essential.

e. The operating handles and cords can be wrapped in towels and sterilized in the autoclave for 10 minutes at 20 pounds pressure. This is considered adequate for most major surgery and does not cause undue deterioration of the bakelite and rubber parts.

11. PREVENTION OF BURNS. a. **Anesthetic.** (1) Ether, ethylene, or other inflammable or explosive anesthetics should not be used. Electrical cutting is done by means of an arc formed between the cutting electrode and the tissue, and such an arc will ignite inflammable gases. Some operators use ether at times in electro-surgery, but its use always introduces an element of danger unless the conditions are such that there

is no possibility of the inflammable gas spreading to the regions of the cutting arc or the gaps of the machine.

(2) When it can be avoided local anesthetic solutions should not be injected directly into the tissue to be cut or coagulated as this introduces much fluid which must be boiled out during the coagulation and tissue destruction may be wider than it immediately appears to be.

b. Prevention of high-frequency burns. Burns are possible either from the indifferent electrode (if improperly prepared and applied) or from the active electrode if it is carelessly handled or laid on the patient when not in use.

(1) Edges of the indifferent plate, 3R01644 (fig. 4) should be turned back on themselves and applied away from the patient's skin. The plate should be rolled flat each time before using (wrinkles, irregularities, or sharp points will cause a concentration of current and probable burns). To insure good contact, the plate and patient's skin should have a generous application of heavy soap lather or lubricating jelly and the plate should not be applied over hair or hard scar tissues. Hair and scar tissue are nonconducting and may cause a concentration of current at other points under the electrode.

(2) When not in use, the chuck handle and active electrode should be placed on a sterilizable instrument rack because, if laid on top of the patient, a burn may result if the foot switch, 3R01656 (fig. 5) is depressed.

c. Accidental ignition of inflammable fluids. When an inflammable fluid (such as alcohol) is used to cleanse the field preparatory to surgery, there is a possibility of igniting any residual liquid by a spark from the electrode. When inflammable fluids or solvents are used, allow sufficient time for complete evaporation and be sure that dressing, coverings, or clothing surrounding the field are not saturated with the liquid.

12. SPECIAL NOTES ON TRANSURETHRAL PROSTATIC RESECTION. **a.** As in all electro-surgical work, power settings for resection should be varied to best suit the immediate conditions. It is always desirable to use the lowest power that will produce the desired results, that is, use the lowest cutting power that resects freely on the particular gland being removed. Use the lowest coagulation power that will effectively control hemorrhage, remembering that the larger the bleeding vessel, the more power required for quick control. The less power used, the longer the loops will last and the less tendency to char and carbonize the sheath.

b. It may be desirable to change power settings in the course of an operation. When starting to resect it is advisable to use the lower power range and if easier cutting is desired, step up the power a few points at a time until it cuts freely.

c. For control of hemorrhage a coagulation power setting around 45 will effectively control oozing or bleeding from the smaller vessels, but in the presence of large individual spurters more power (around 55) should be applied for effective, rapid control.

d. For sterilizing prostatic resection instruments, the customary mercuric cyanide solution used for cystoscopes is recommended. Alcohol or phenol should not be used on the resection instruments as they may cause deterioration of some of the parts.

e. If machine does not cut in prostatic resection, with all of the points checked as listed in paragraph 9b and c, it may indicate—

(1) A defective loop; change loops immediately.

(2) The irrigating medium is of high chemical content. If in doubt, only distilled water should be used.

SECTION IV

PREVENTIVE MAINTENANCE AND REPLACEMENT OF PARTS

13. PREVENTIVE MAINTENANCE. **a. Care of machine.** (1) When not in use, the machine should be kept clean and covered.

(2) For best performance, the gap adjustment should be made each day before operations are started. While the gaps will, under ordinary circumstances, retain their adjustment over quite a period of time, they may get slightly out of adjustment if the machine is moved around or jolted, and for assurance of satisfactory performance, a complete gap adjustment is recommended each day before starting to work.

(3) To clean spark gaps, obtain a strip of #000 sandpaper. Fold this strip so that there is an abrasive side on both sides. Open the spark gaps by turning the spark gap adjustment knob, 3R01650 (figs. 2 and 6) counterclockwise until the doubled strip of sandpaper can be placed between the sparking surfaces, and then close the gaps until a slight friction on the sandpaper is felt. Carefully draw the sandpaper between the gaps a few times.

(4) After cleaning the gaps make certain that any sand that may have been left between the gaps is removed. This can be done by drawing a clean strip of paper through the gaps in exactly the same manner as the sandpaper.

b. If unable to make gaps fire—(1) Make sure that machine is connected to correct current supply.

(2) Make sure that the supply line is not "dead" because of burned out fuses or other reasons. Pilot light, 3R01654 (fig. 2) will glow when machine is connected to proper supply current and selector switch (fig. 2) is on "Scalpel" or "Coagulation" position. If pilot light, 3R01654 (fig. 2) does not glow, look for trouble in the supply line.

(3) See that foot switch, 3R01656 (fig. 5) is connected.

(4) See that current selector (fig. 2) is on "Scalpel" or "Coagulation" position.

(5) Occasionally some unauthorized person may start to "play" with the machine and close one or more gaps several turns or open them up a number of turns. If this occurs, it may appear impossible to get the gaps to fire.

(a) The first thing to do is to close all gaps completely by turning each adjustment knob clockwise until resistance is felt. This may re-

quire anywhere from two or three to twenty or thirty turns depending on whether gap is partially open or closed at the start.

(b) After all gaps are completely closed, proceed to adjust gaps as in figure 7.

c. If the machine does not cut properly, check the following points to ascertain that—

- (1) Machine is connected to correct current supply.
- (2) Current supply is alive. Be sure that the fuses on the line are of sufficient capacity to carry the machine as well as anything else on the line.
- (3) Current selector (fig. 2) is on "Scalpel" position.
- (4) All spark gaps are correctly adjusted and firing with equal intensity without sputtering.
- (5) High frequency cord (fig. 4) from operating electrode is connected to the machine.
- (6) Indifferent electrode, 3R01644 (fig. 4) is firmly in contact with patient's bare skin and connected to machine.
- (7) Power control is properly set.

d. Cutting under water requires electrodes with insulated shanks so that all current will be concentrated on the cutting area of the electrode. The uninsulated open-air electrode will not cut under water because a larger proportion of the cutting current will be dissipated into the water from the bare shank of the electrode. Therefore, do not expect to cut under water except with electrodes designed especially for that purpose.

14. REPLACEMENT OF PARTS. Replacement of parts in the field should be limited to parts that require no technical knowledge to accomplish. Therefore, in the event anything goes wrong, return the unit to be repaired. The following is a list of parts easily replaced with notes on how to replace them:

a. **Holder, Handle, Switch, Selector, Plastic, 3R01668.** (1) To remove:

- (a) Unscrew setscrew in base of holder with screw driver.
- (b) Pull holder off shaft.

(2) To replace:

- (a) Replace new holder on shaft.
- (b) Insert and tighten setscrew.

b. **Holder, Handle, Control, Power, Plastic, 3R01672.** (1) To remove:

- (a) Loosen setscrew using 3/32" Allen wrench.
- (b) Pull holder off shaft.

CAUTION: Make sure setscrew lines up with mark of previous setscrew on shaft.

(2) To replace:

- (a) Replace holder on shaft.
- (b) Tighten setscrew.

c. **Panel, Case, Rear, with four ventilating grids, 3R01714.** (1) To remove:

- (a) Lay unit on front side.
- (b) Remove four washerhead screws.
- (c) Insert finger in hole and lift off.

(2) To replace:

- (a) Insert left side with clip on first.
- (b) Insert and tighten four washerhead screws.

d. **Knob, Spark Gap, Adjustment, 3R01650.** (1) To remove:

- (a) Remove rear panel (c above).
- (b) Loosen setscrew with small screw driver, holding knob to spark gap assembly.

(c) Pull knob out through hole in top panel.

(2) To replace:

- (a) Insert knob through hole in top panel.
- (b) Tighten setscrew.
- (c) Replace rear panel (c above).

e. **Gap, Cutting, Four-Gap, Complete: Assembly, 3R01652.** (1) To remove:

- (a) Remove rear panel (c above).
- (b) Remove adjustment knob (d above).
- (c) Unscrew thumb nuts securing assembly to bracket.
- (d) Lift assembly straight out.

(2) To replace:

- (a) Fit assembly on brackets.
- (b) Replace lock washers and screw thumb nuts tight.
- (c) Replace adjusting knobs (d above).
- (d) Replace rear panel (c above).

f. **Frame, Observation Window, Plastic, 3R01696.** (1) To remove:

- (a) Remove rear panel (c above).
- (b) Remove spark gap assembly (e above).
- (c) Remove four screws holding frame to top with short screw driver.

(2) To replace:

(a) Insert four screws through spark gap assembly bracket and tighten to frame.

- (b) Replace spark gap assembly (e above).
- (c) Replace back panel (c above).

g. **Window, observation, 2 1/8" X 5 3/8": glass, colored, 3R01694.**

(1) To remove:

- (a) Remove window frame (f above).

(b) Push window out of frame.

(2) To replace:

(a) Place window in frame and insert flat spring to hold in place.

(b) Replace window frame (f above).

h. Cover, spark gap adjustment knob, plastic: assembly, 3R01698.

(1) To remove:

(a) Remove window frame (f above).

(b) Remove two screws holding flat springs in place.

(2) To replace:

(a) Fit in window frame.

(b) Replace flat spring and tighten screws.

(c) Replace window frame (f above).

i. Handle, carrying case, leather, 3R01662. (1) To remove:

(a) Remove rear panel (c above).

(b) Remove four screws holding clamps with screw driver holding nut on inside with socket wrench.

(2) To replace:

(a) Fit clamp on handle.

(b) Insert screw through holes in side of case and tighten on nut.

(c) Replace rear panel (c above).

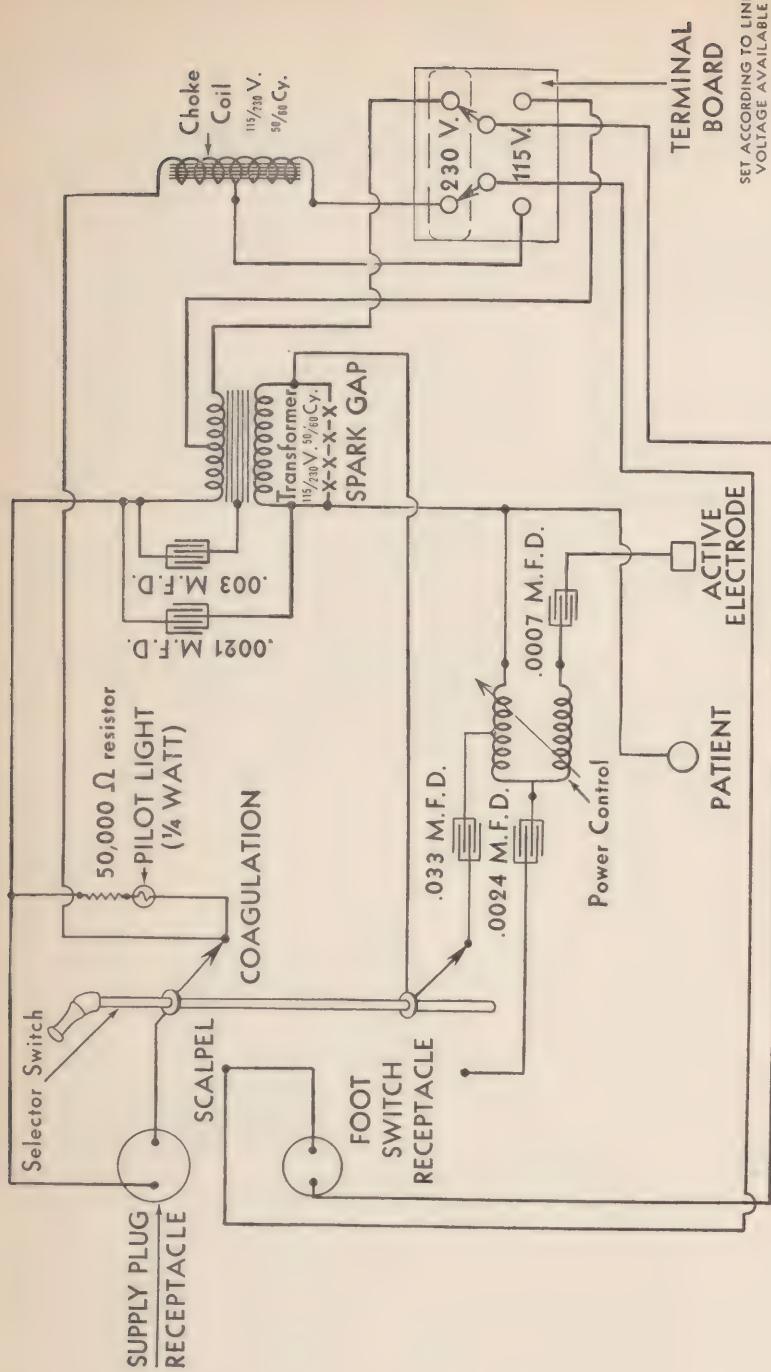


Figure 8. Wiring diagram.

APPENDIX

STANDARD NOMENCLATURE LIST OF PARTS

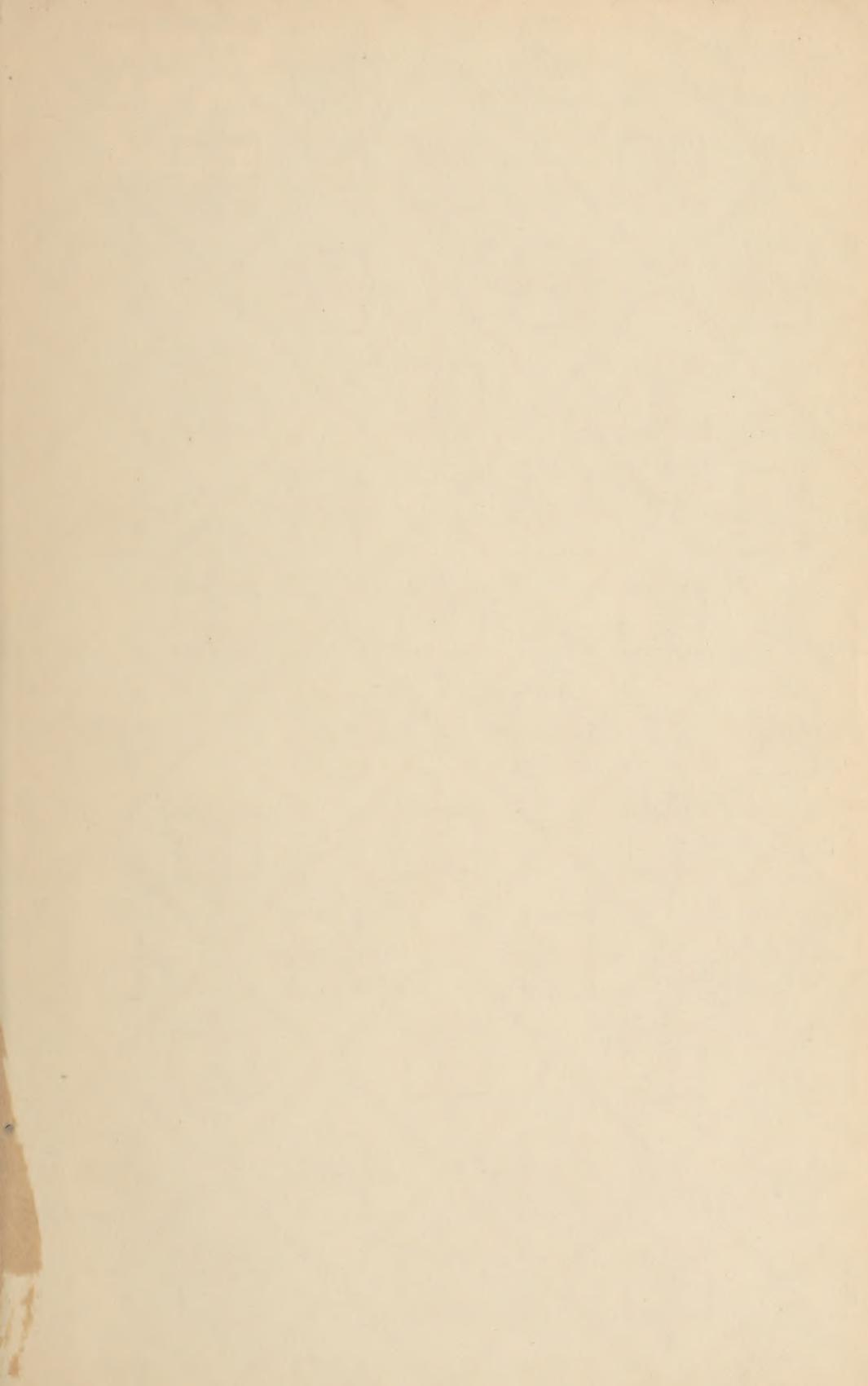
<i>Medical Dept. No.</i>	<i>Nomenclature</i>	<i>Figure No.</i>
COMMON PARTS		
*SR00045	SCREW, 10-32 X 3/8 INCH, R.H.M.: Used in clamp for cover handle	—
*SR00142	SCREW, 10-32 X 3/8 INCH, R.H.M.: Used in mounting of power control and choke coil	—
*SR00143	SCREW, 10-32 X 1 INCH, R.H.M.	—
*SR00151	WASHER, LOCK, Screw Size 10	—
*SR00185	NUT, 8-32, HEX., BRASS: Used in various wiring connections	—
*SR00232	SCREW, 10-32 X 7/8 INCH, R.H.M.	—
*SR00273	NUT, 10-32, HEX., BRASS	—
SR00274	SCREW, 5 X 3/8 INCH, R.H., WOOD	—
SR00275	SCREW, 6 X 1 INCH, PHILLIPS HEAD, WOOD: Used in receptacle bracket	—
SR00276	SCREW, 10-32 X 1 1/8 INCH, WASHER HEAD MACHINE: For rear panel	—
*SR00277	WASHER, SHAKEPROOF, NO. 10, INTERNAL TEETH: Used in various mountings	—
SR00278	SPACER, 1/2 INCH O.D. X 1/4 INCH I.D., 3/8 INCH THICK: For terminal board	—
*SR00279	WASHER, 3/8 INCH, BRASS	—
SR00280	SCREW, 8-32 X 5/8 INCH, FILL. H.M.: Used as setscrew in selector switch handle holder	—
*SR00281	SETSCREW, 10-32 X 3/16 INCH, ALLEN, CUP PT.: Used in power control handle holder and to secure adjustment knobs	—
SR00282	SCREW, 5 X 3/8 INCH, PHILLIPS HEAD, WOOD	—
SR00283	WIRE, NO. 12, COPPER, SOLID, UNCOVERED	—
SR00284	WIRE, NO. 12, FLAMENOL, STRANDED, BLACK	—
SR00285	SCREW, 6 X 5/8 INCH, PHILLIPS HEAD, WOOD: Used in plastic wire clamps	—
SR00286	TUBING, 1/2 INCH, FIBRE, SOLID: Used to protect wiring	3
SR00287	STRAP, PIPE, 1/2 INCH, ONE HOLE: For securing fibre tubing	3
SR00288	SCREW, 5 X 1/2 INCH, PHILLIPS HEAD, WOOD: Used in pipe straps and bulb base	—
SR00289	SCREW, 6 X 7/8 INCH, PHILLIPS HEAD, WOOD: Used in receptacle bracket	—
SR00290	SCREW, 6 X 3/8 INCH, FLAT HEAD, WOOD: For top panel	—

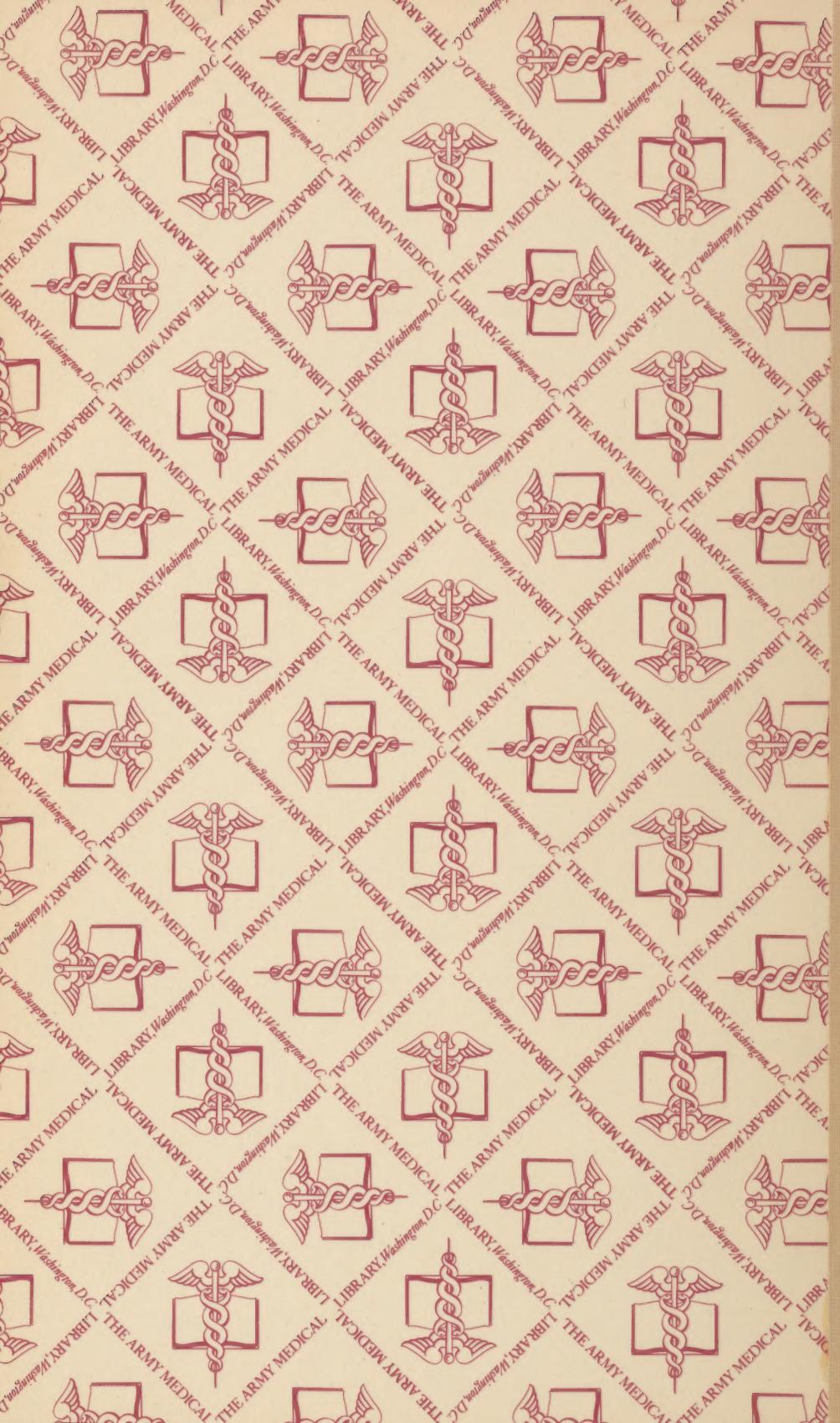
<i>Medical Dept. No.</i>	<i>Nomenclature</i>	<i>Figure No.</i>
SR00291	SCREW, 10-32 X 1 1/8 INCH, R.H.M.: Used to attach mounting board to case	—
*SR00293	WASHER, 1/4 INCH	—
*SR00294	WASHER, SHAKEPROOF, NO. 8 INTERNAL TEETH: Used in various wire connections	—
SR00295	TERMINAL, CLAMP, WIRE, 1/2 INCH, O.D. 3/16 INCH HOLE, 3/4 INCH LENGTH	—
SR00296	TERMINAL, CLAMP, WIRE, 1/4 INCH, O.D. X 3/16 INCH HOLE, 1 INCH LENGTH	—
*SR00297	WASHER, SCREW SIZE 10	—
*SR00299	SCREW, 10-32 X 3/8 INCH, R.H.M., BRASS	—
*SR00300	SCREW, 10-32 X 1/2 INCH, R.H.M.: Used to secure condenser to selector switch	—
SR00338	SCREW, 8-32 X 1/4 INCH, R.H.M., BRASS	—
SR00339	SCREW, 8-32 X 1/2 INCH, R.H.M., BRASS	—
	UNCOMMON PARTS	
*3R01602	NOSE, CHUCK: For long chuck	4
*3R01604	HANDLE, STERILIZABLE	1,4
*3R01606	HANDLE, LONG CHUCK, COMPLETE: With square plug and cord	4
*3R01608	GRIP, OFFSET: For long chuck handle	4
*3R01610	ROLLER, ELECTRODE, RUBBER	4
*3R01612	HANDLE, SHORT CHUCK, COMPLETE: With square plug and cord	4
*3R01614	CASE, ELECTRODE, COMPLETE	3
*3R01616	CORD, HIGH FREQUENCY, COMPLETE: With square plug	4
*3R01618	CORD, PATIENT, COMPLETE: With round plug and rubber covered clip	4
*3R01620	PLUG, ADAPTOR	4
*3R01622	ELECTRODE, SMALL BLADE, STRAIGHT	4
*3R01624	ELECTRODE, LARGE BLADE, STRAIGHT	4
*3R01626	ELECTRODE, SMALL NEEDLE	4
*3R01628	ELECTRODE, LARGE NEEDLE	4
*3R01630	ELECTRODE, ROUND LOOP, 1/4 INCH	4
*3R01632	ELECTRODE, ROUND LOOP, 5/16 INCH	4
*3R01634	ELECTRODE, BALL, 1/8 INCH	4
*3R01636	ELECTRODE, BALL, 3/16 INCH	4
*SR01638	ELECTRODE, LOOP, NEURO-SURGICAL, 1/4 INCH	4
*SR01640	ELECTRODE, LOOP, NEURO-SURGICAL, 5/16 INCH	4
*3R01642	ELECTRODE, NEEDLE, NEURO-SURGICAL	4
*3R01644	ELECTRODE, PATIENT, METAL	4
*3R01646	CABLE, SUPPLY, COMPLETE: With plug and receptacle	5
*3R01648	NUT, SPARK GAP, MOUNTING	6
*3R01650	KNOB, SPARK GAP, ADJUSTMENT	2,6
*3R01652	GAP, CUTTING, FOURGAP, COMPLETE: Assembly	3,6
*3R01654	BULB, PILOT, 1/4 WATT, 110 V.	2,6
*3R01656	SWITCH, FOOT, COMPLETE: With cord and plug	5
*3R01658	SLEEVE, SHORT CHUCK HANDLE, BAKELITE	4
*3R01660	TIGHTENER, SHORT CHUCK HANDLE	—

Medical Dept. No.	Nomenclature	Figure No.
3R01662	HANDLE, CARRYING CASE, LEATHER.....	1
3R01664	CLAMP, CARRYING CASE HANDLE.....	1
*3R01666	SWITCH, SELECTOR, COMPLETE: Assembly.....	3
*3R01668	HOLDER, SELECTOR SWITCH HANDLE, PLASTIC.....	2
*3R01670	CONTROL, POWER, COMPLETE: Assembly.....	3
*3R01672	HOLDER, POWER CONTROL HANDLE, PLASTIC.....	2
*3R01674	COIL, CHOKE, 115/230 V., 50/60 C.....	3
*3R01676	CONDENSOR, .0024 MF.....	—
*3R01678	CONDENSOR, .0007 MF.....	—
*3R01680	CONDENSOR, .033 MF.....	—
*3R01682	CONDENSOR, .0021 MF.....	—
*3R01684	CONDENSOR, .003 MF.....	—
*3R01686	RESISTOR, 50,000 OHMS.....	—
*3R01688	BRACKET, RECEPTACLE, COMPLETE: For supply and foot switch attachment.....	3
*3R01690	RECEPTACLE, FEMALE, TWO PRONG: For foot switch attachment.....	1
*3R01692	PLUG, MALE, TWO PRONG, RECESSED: For power supply attachment.....	1
*3R01694	WINDOW, OBSERVATION, 2 1/8 INCH X 5 3/8 INCHES, GLASS: Colored.....	2
*3R01696	FRAME, OBSERVATION WINDOW, PLASTIC.....	2
*3R01698	COVER, SPARK GAP ADJUSTMENT KNOB, PLASTIC, COMPLETE: Assembly.....	2
*3R01700	GUIDE, ACTIVE ELECTRODE PLUG, PLASTIC, SQUARE.....	2
*3R01702	GUIDE, PATIENT ELECTRODE PLUG, PLASTIC, ROUND.....	2
3R01704	CASE, CARRYING, COMPLETE: With hasps.....	1
3R01706	COVER, CARRYING CASE, COMPLETE: With compart- ment for accessories.....	—
3R01708	HANDLE, CARRYING CASE COVER, COMPLETE: With steel rings.....	1
3R01710	CLAMP, HANDLE, CARRYING CASE COVER.....	—
3R01712	PANEL, REAR CASE, COMPLETE: With four ventilating grids.....	—
3R01714	CLIP, RETAINING, REAR PANEL.....	—
3R01716	GUARD, SUPPLY PLUG: To prevent removal of panel when supply plug is in.....	—
3R01718	STOP, FINGER: Attached to inside of rear panel.....	—
3R01720	BOARD, TERMINAL: For adjusting voltage 115/230 V.....	3
*3R01722	SPRING, OBSERVATION WINDOW: Used to hold win- dow in frame.....	—
3R01724	TRANSFORMER, 115/230 V., 50/60 C., COMPLETE: As- sembly.....	3
3R01726	BASE, PILOT BULB.....	—
3R01728	BRACKET, MOUNTING, LEFT: For spark gap assembly.....	—
3R01730	BRACKET, MOUNTING, RIGHT: For spark gap assembly.....	—
3R01732	WIRE, WOVEN, COPPER: Jamper between condensor and switch.....	—

<i>Medical Dept. No.</i>	<i>Nomenclature</i>	<i>Figure No.</i>
3R01734	CLAMP, WIRE, PLASTIC: Used to secure leads from coil and transformer	3
3R01736	RECEPTACLE, ELECTRODE PLUG: For electrode cord attachment	—
3R01738	PANEL, TOP, PLASTIC: For carrying case.....	2
3R01740	BOARD, MOUNTING, 10 1/4 INCH X 15 3/8 INCH X 5/8 INCH, BOTTOM, WOOD	3
3R01842	BOARD, MOUNTING, 11 INCH X 17 INCH X 3/4 INCH, TOP, WOOD	—
*3R01744	WASHER, COIL, SPRING, No. 10: Used in spark gap mount- ing and terminal board	6

* To be requisitioned when required from the supply depot.





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